Solid Waste Management — The Lagos State Experience

By

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Synopsis

This paper describes briefly the attempts by the Lagos State Government to control the collection and disposal of solid wastes in the Metropolitan Lagos and thus render the environment more hygienic and cleaner to live in. It describes the structure of the organization charged with the responsibility of collecting and disposing refuse in the State i.e., the Lagos State Refuse Disposal Board established under Edict No. 9 of 1977. For operational reasons the Metropolis of Lagos was divided into three Regions and each region sub-divided into two, three or four zones. Plant, equipment, and personnel were distributed into the zones in accordance with the volume of refuse generated in each zone.

The paper also describes the disposal methods now in use viz sanitary landfill but also touches on other forms of solid waste disposal which are incinerating and composting, and concludes by stating the immediate problems of the Board.

Introduction

Lagos State emerged in May 1967 when as part of the momentous nation-wide State creation exercise, the Federal Military Government merged both the then Federal Territory of Lagos and the old colony province of Western Nigeria into a single full-fledged State within the Federation of Nigeria. As a result of the creation of seven more States in 1976 Lagos State is now one of the nineteen States of the Federation of Nigeria.

The Lagos State covers an area of about 3,600 square kilometres and has a population of over 4m people. Out of the nineteen States forming the Federation of Nigeria, Lagos State has the highest population density. For ease of administration and in order to bring the Government right down to the people's doorsteps, the State has been divided into eight Local Government Areas, namely; Lagos Island, Lagos Mainland, Mushin, Shomolu, Ikeja, Ikorodu, Epe and Badagry, while Ikeja occupies prominent and unique position by virtue of its being the Administrative Capital of the State and the seat of the State Government.

Topography of Metropolitan Lagos

In general Lagos is situated in the flat coastal dense forest of Nigeria with swamps, marshes and lagoons. The extreme flatness of the terrain is a striking feature of the area.

The terrain descends from the North to the continental shelf of the shores of the Atlantic Ocean at the South. It has a low, gently sloping dissected character and has an average elevation of 30 metres above sea level. Ikeja plains is at 15 metres contour and some 15–20 kilometres from the sea shores. The slope averages about 0.1%. This extremely flat land has two broad distinctive geological formations. From Ilaro formation in Ogun State to the sea coast (Lagos State) a distance of about 40 kilometres is divided between the coastal plain sands North of Yaba and a recent deposit of alluvium and other loose material towards the sea coast. (Fig.1).

The water table is very high at the coastal area depending on the ground elevation and the regional slope of the water table. In the Lagos-Apapa, Ikoyi area, the water table is less than 3 metres. In the low-lying residential areas of southern Ikoyi and Apapa the ground water has been found to occur at usually about 1.0–2.0 metres below the ground level.

The flat terrain coupled with poor sub-soil conditions and high water table causes the very poor drainage in the area which creates ultimately the main problem of scarcity of available land for development and makes land reclamation superficially very attractive.

Population Growth and Economic Development

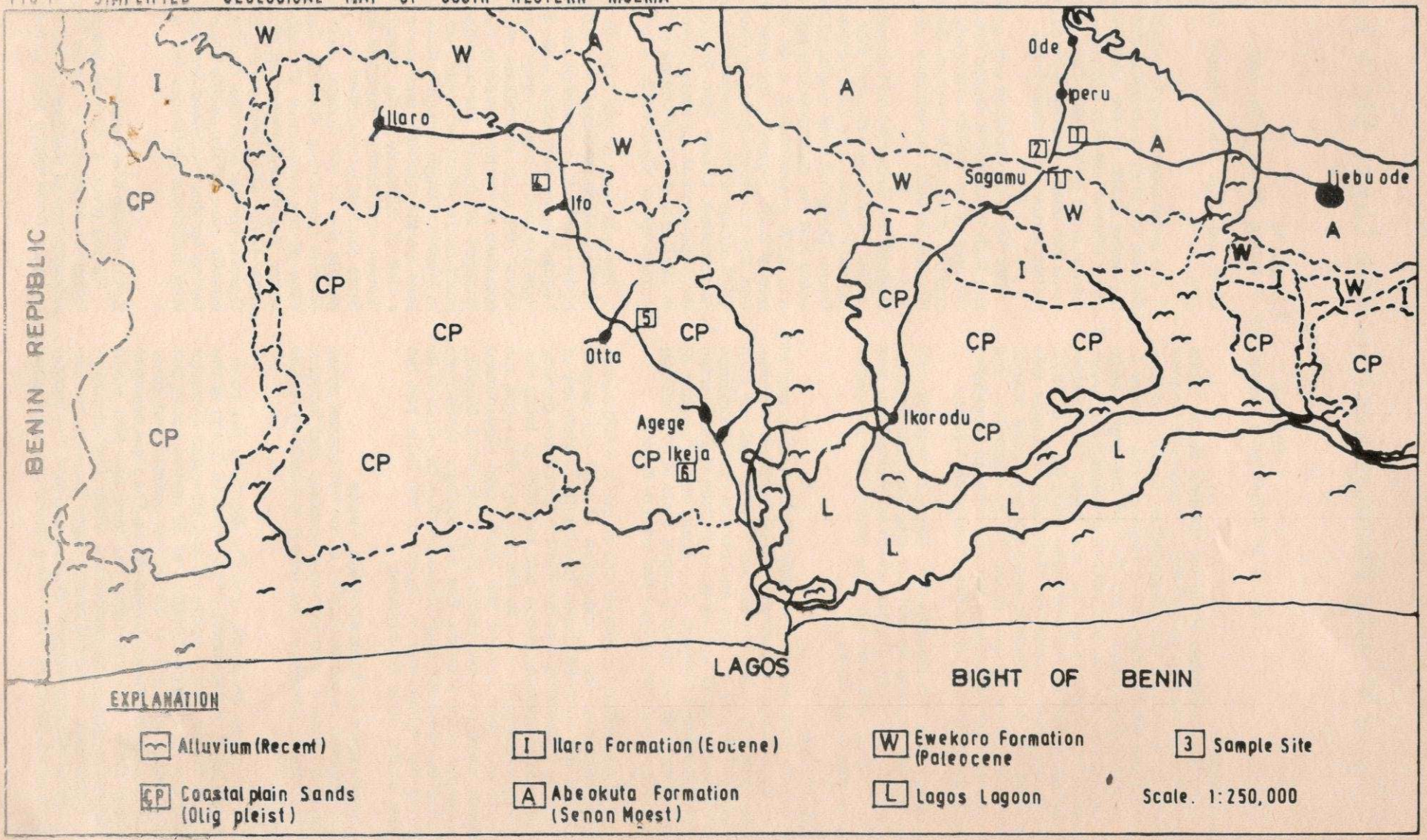
The 1963 census showed that Lagos State had 1.44 million inhabitants or 2.6% of the total Nigerian population. The provisional results of the 1973 census indicated that the corresponding figures were 2.47 million and 3.1% corresponding to an average annual growth rate of 2.2%. However, the later census was cancelled and the un-official point of view in Lagos is that the 1973 census underestimated the true figures. The Lagos Metropolitan Master Plan Project Report (1976) puts the population of the Metropolitan Lagos at 3.5 million in 1975 and at 4.3 million by 1980 corresponding to a growth rate of about 6.5%.

The economy of the State is divisible into activity frontiers which are desirably knit together like the pieces of an inter locking jigsaw puzzle. The old city Island of Lagos and its metropolis have a unique feature—the high preponderance of wage earners which constitute about 70% of its inhabitants; the municipality and the suburban perimeter embracing the major manufacturing factories at Apapa, Iganmu, Ijora together with the multi-range industrial estates which extend from Yaba to Mushin through Ilupeju to Ikeja. Beyond this industrial zone are the relatively rural communities which inhabit a belt of vegetation and stretched from Epe across Ikorodu and North of industrial Ikeja to Badagry Lagos State can best be described as a "Marine State" whose people live in the Coastal areas of Lagos City and Victoria Island, Epe, Ikorodu, Badagry and Eti-Osa. In view of the prevalence of Lagoons, rivers and fresh water, the natural resources of the State are mainly water-borne and these consist of fish, prawns, crabs, Oysters, Lobster and other aquatic invertebrates. Consequently many of the people depend to a large extent on fishing for their livelihood and most of them are people with traditional preference for fish diet.

Solid Waste Management

Having given a clear picture of Lagos State in the foregoing exposition, it is now intended to discuss the salient theme of this paper, "Solid Waste Management" in Lagos State which prior to the establishment of the

FIG 1 SIMPLIFIED GEOLOGICAL MAP OF SOUTH WESTERN NIGERIA



Refuse Disposal Board used to be one of the functions of the Local Governments.

With the unprecedented urban expansion in Nigeria, the Metropolis of Lagos, unique for its dual status, has had more than its fair share of rapid population growth and consequently the magnitude of the sanitation problems being encountered in Lagos State differ considerably from those of other States in the Federation of Nigeria. Sequel to the tremendous increase in population during the last few years, the pace of refuse generation out-stripped the existing refuse collection and disposal facilities and inevitably much refuse remained uncollected in frightful heaps scattered throughout many parts of the Metropolis of Lagos which embraces Lagos Island and Mainland, Shomolu, Mushin and Ikeja Local Government Areas. Lack of sufficient trained staff, too few collection vehicles and equipment, inadequate repair facilities, non-availability of spare parts and absence of suitable disposal outlets contributed in no small measure to the problems of sanitation in the Metropolis. It then became crystal clear that the organisation and equipment being used by the Local Governments were grossly inadequate to cope with the strains and stresses of the responsibility of collection and disposal of the enormous quantity of refuse generated. Consequently, refuse houses in most parts of the Metropolis were filled up and the garbage over flowed to the streets.

Establishment of Lagos State Refuse Disposal Board

To save this deplorable situation by controlling the overall sanitation of Lagos State in general and Lagos Metropolis in particular, before further deterioration of public sanitation reared its head, the Lagos State Refuse Disposal Board was established to cater for the collection, removal and disposal of refuse. The birth of the Board was ushered in by the promulgation of an Edict by the Lagos State Government (1977) titled. "Refuse Disposal Board Edict (No. 9)", 1977 and an inter-Ministerial Committee was immediately set up as the Interim Board.

The Interim Board consisted of five Civil Commissioners, some Co-opted members including the Chairmen of Local Government Areas in which the Board was operating, as well as two ex-officio members. Although the primary function of the Board was the removal, collection and disposal of refuse, it also had responsibility for the continuous up-dating of master plans for refuse collection and disposal in the State.

Under a contract with the Lagos State Government, Powell Duffryn Pollution Control Ltd. of Great Britain was engaged to provide consultancy and Project Management Services to the State Refuse Disposal Board with a view to creating the organisation and the infrastructures necessary for the efficient and effective operation of refuse collection and disposal in the State.

Tied up with this, was another contract for the supply of 70 Mammoth and 27 Dinosaur refuse vehicles together with 1,000 specially designed mammoth containers. In addition to all these, the Board also bought an appreciable number of tipper lorries, mechanical shovels and other ancillary equipment.

The interim Board had its maiden meeting on the 13th of July 1977. Within a very short time, a remarkable improvement in the refuse collection service in the State was noticeable. This measure of success was attributable to the division of Lagos Metropolis into three Regions. Region 1 being the largest was subdivided into four zones, Region II was subdivided into two zones while Region III also consisted of two zones.

For effective administrative Management the Board operated under a Chairman who was the State Commissioner for Local Government and Chieftancy Affairs assisted by other Board members, the Chief Executive who was responsible for the implementation of Board's policies, and the Secretary to the Board. All other staff of the Board came under one of the three divisions of the Board which were Administrative, Operations and Maintenance. The Secretary to the Board was the head of the General Administration Division, while the Director of Operations and Maintenance Executive were the heads of the Operations and Maintenance Divisions respectively. The organisational structure is given in Fig. 2.

Operational Organisation Refuse Collection

As mentioned earlier, the Metropolitan area of Lagos had been divided into three regions, for effective operational reasons:-

Region 1: This comprised Ikoyi, Victoria Island, Lagos and Apapa Islands, and the Mainland areas of Surulere, Ebute-Metta and Yaba.

The region was split into four zones and a zonal depot established in each. All operational vehicles and personnel were located and managed from these depots.

Work commenced in this region on the 1st April, 1978 and by July, 1978 all areas were receiving some form of refuse collection service and most of the major refuse heaps had been cleared. Many problems still remained but a discernible improvement in environmental sanitation had been achieved.

Wherever possible, a door to door or kerbside collection service was provided, using the Mammoth vehicles, at least once a week. Inaccessible areas were served by a communual collection service using 1.6m^3 Mammoth bins or the very large 26m^3 Dinosaur containers. These bulk bins were located at strategic points or where, traditionally, the public were used to depositing refuse. This service was more frequent and often these bulk containers were emptied two or three times a week depending on their patterns of use.

Region 2: This consisted of parts of Mushin and Shomolu Local Government areas. In November 1978, service was given to Mushin which was designated as Zone 1 with the zonal depot along Isolo Road. The Shomolu area (Zone 2) was entered in February, 1979. The zonal depot was at Gbagada.

Many of the initial problems encountered Region 1 were also experienced here and initial operations were hindered by the inaccessibility of the more densely populated area, the problems of flooding and road traffic congestion. Despite all these, a regular refuse collection service was established, large accummulations of wastes were cleared and a system similar to Region 1 now operates.

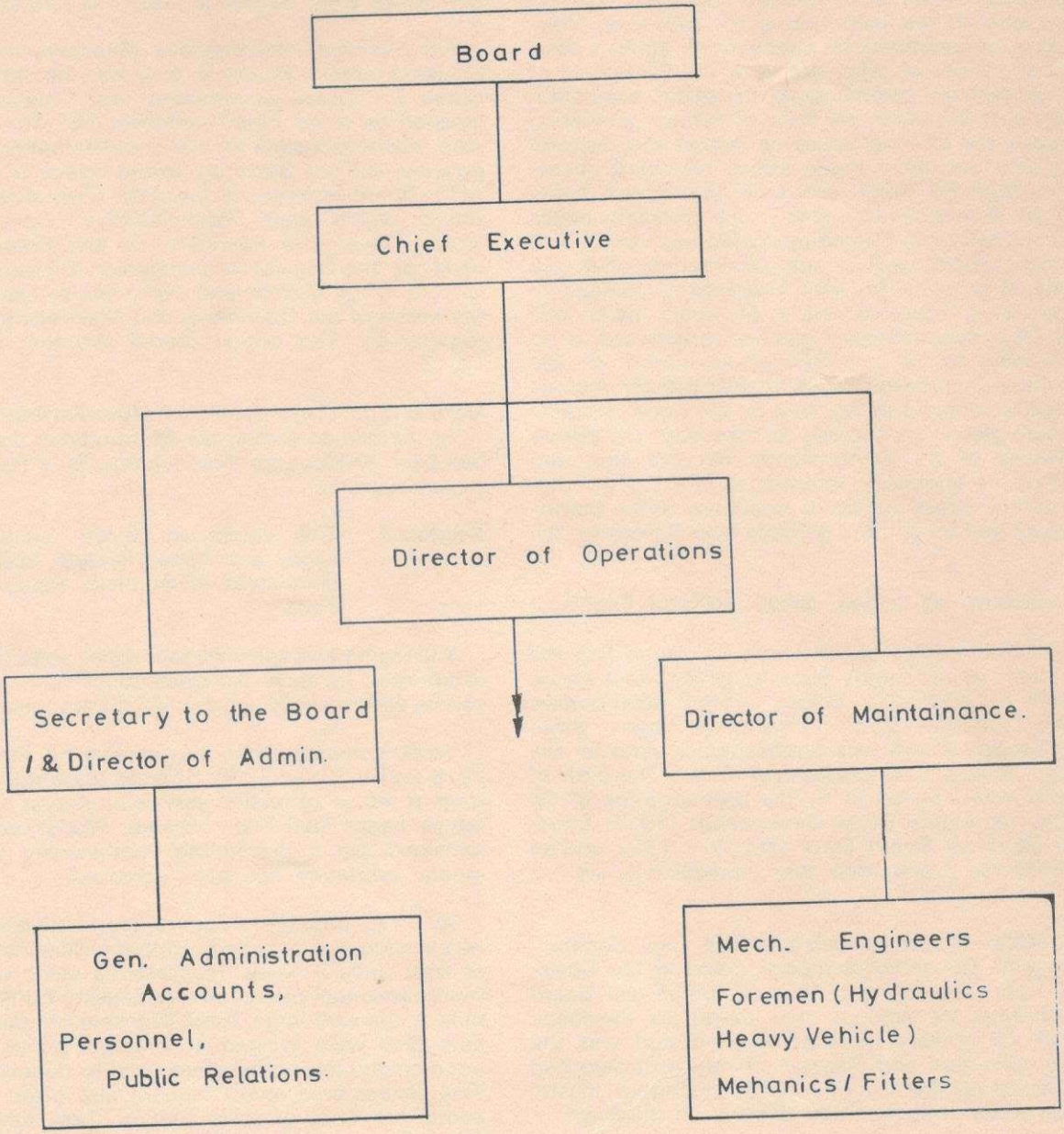


Fig. 2 Organizational Structure of the Lagos State Refuse Disposal Board

TABLE 1

DETAILS OF OPERATIONAL ORGANISATION

Region			Vehicles & Equipment	Operational Staff
1	Ikoyi, Victoria Island, Obalende Central Lagos, Iddo, Ebute-Metta Apapa, Yaba, Surulere, Abule-Ijesha and part of Ikorodu Road Junction of Fadeyi		7 Dinosaurs 33 Mammoths 46 Tippers 4 Kukas 9 Side Loaders 9 Mechanical Shovels 42 Dinosaur Containers 408 Mammoth bins 26 Tractor bins 39 Communal bins 5 Tractors + Spares.	663
	Zone 1:	*Simpson Street-Lagos Depot*: to serve Lagos Island, Ikoyi and Victoria Islands		
	Zone 2:	*Alhaji Masha Depot:* to serve the whole of Surulere.		
	Zone 3:	*Burma Road Depot*: to serve Apapa G.R.A. and Industrial Sector of Apapa.		
	Zone 4:	*Rowe Park Depot*: to serve Iddo, Yaba, Fadeyi, Ebute-Metta, Oyingbo and Abule Nla.		
2.	Zone 1:	Mushin Local Goverment area including Maryland, Ilupeju some parts of Airport Road, Mafoluku.	8 Dinosaurs 22 Mammoths 53 Tippers 4 Side Loaders 3 Mechanical Shovels 40 Dinosaur Containers 290 Mammoth bins + Spares	498
	Zone 2:	Shomolu Local Government area including Bariga, Akoka, Anthony Village.		
3.	Zone 1:	Ikeja Local Government area, Ogba, Agege and neighbouring Areas.	8 Mammoths 8 Tippers 2 Side-loaders 4 Mechanical Shovels 24 Containers 350 Mammoths bins + Spares.	278
	Zone 2:	Badagry Local Government area including Festac-Village, Satellite Town Ajegunle (Apapa) etc.		

Region 3: This included the remaining geographical areas of metropolitan Lagos i.e., Ikeja, Agege, Mafoluku, Oshodi, Ketu, Ojota and parts of Badagry Local Government Area including Festac Town, Satellite Town, Amuwo Odofin and Ajegunle. Work started in this region on 4th June, 1979. The region was divided into two zones with zonal depots at Ikeja and along Badagry Express Way.

The details of operational organization are given in Table 1.

Operational Command Structure

Effective Communications constitute a major problem because of the distances to the Headquarter offices of the Organisation situated at Iddo Yard (Ijora). This highlights the necessity for a radio link with all the zonal depots and the developments of the Ikeja depot as full maintenance workshop.

However, a human chain of command linking the operational staff with the Director of Operations is given in Fig. 3.

Vehicles and Equipment

The following equipment were ordered at the inauguration of the Board:-

1,000 No. 1.6m^3 capacity containers specially designed for automatic hydraulic pick-up by the refuse Mammoth vehicles

70 No. Mammoth Rear-Loading Compacting refuse vehicles with nett payload of 9 tonnes. The vehicles are equipped with hydraulically operated pick-up system to automatically employ the 1.6m^3 containers.

27 No. "Dinosaur" type container Handling Units. This Unit is a one-man operation whereby the loading and off-loading is operated from the driver's seat.

120 No. "Dinosaur" Containers of capacity 26m^3.

36 No. "Tipper" Lorries.

The superstructure of the vehicles are mounted on heavy duty DAF Chassis. DAF TRUCKS Ltd had to modify the specifications of the three Chassis Models (Mammoth, Dinosaur and Tipper Lorries) to take the particularly rough handling they would receive both on the very bad roads and on the refuse tips. For example, the springs and clutch plates had to be reinforced to withstand the additional stresses imposed due to rough usage. All vehicles were given good anti-corrosion protection.

In addition to the above, spare parts worth about 15% of the total cost of the above-mentioned equipment were ordered. It was estimated that these spare parts would last two years but because of the unfamilarity of the workers with the vehicles the spare parts were quickly consumed within one year.

A number of tipper lorries were taken over from the Local Governments, and included in the fleet of vehicles

Fig 3 Operational Command Structure - Regions and zones

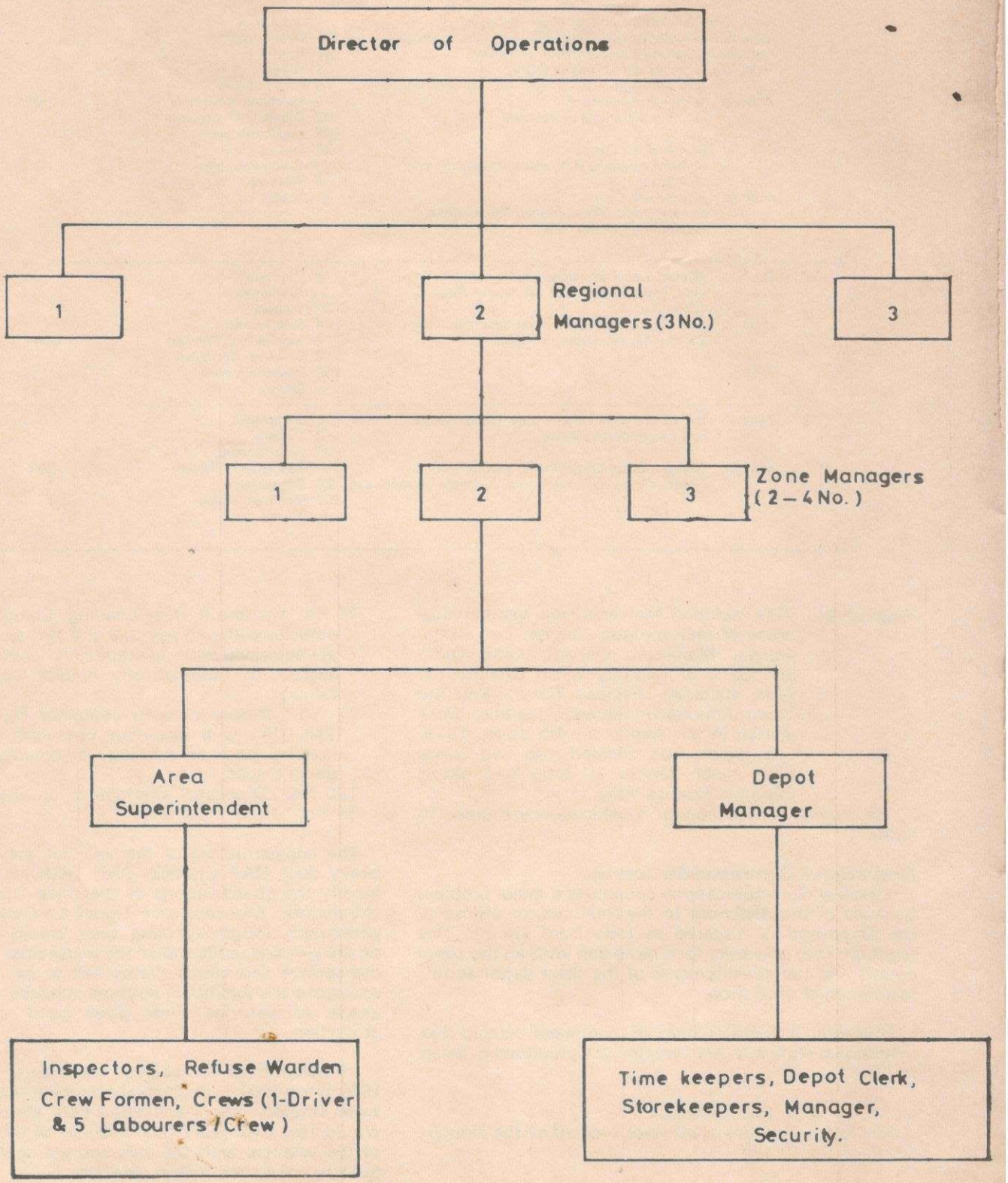


TABLE 2

REFUSE ANALYSIS IN THE LAGOS AREA 11TH JUNE 1976

Material	Location		
	High Density Area (%)	Low Density Area (%)	Commercial Area (%)
1. Sand, Dust and Cinder	2.80%	12.0%	4.2%
2. Vegetable, (Leaves etc.)	63.5%	41.3%	3.5%
3. Paper and Cardboards	24.1%	27.6%	76.7%
4. Metals, Tins etc.	3.0%	6.6%	0.7%
5. Textiles, Rags etc.	1.7%	3.5%	—
6. Glass and broken bottles	0.6%	2.5%	1.4%
7. Plastic, Rubber and Leather	0.8%	3.0%	2.0%
8. Special Category (Bones etc)	1.0%	—	—
9. Unclassified Items	2.5%	3.5%	11.5%
10. Moisture Content:	75.0%	45%	5.5%

owned by the Board. In addition other items of equipment e.g., bull dozer, mechanical shovels etc., were purchased locally.

The deployment of all vehicles and equipment is given in Table 1.

Composition of Refuse Generated

The composition and density of refuse generated in a locality depend largely on the population of the area involved and the degree of commercial and industrial activities in the area.

The standard of living of the residents in the area also plays a significant role in the composition and density of refuse generated. It is generally known that a high-standard of living often results in the greatest use of pre-packed and tinned foods and the more frequent change of items of furniture and fittings.

Recent analysis of the composition of typical refuse in Lagos area (Table 2) indicates that vegetable or organic matter forms the largest percentage of domestic refuse (i.e. 63.5% in high density area and 41.3% in low density area) whereas in commercial areas, paper and cardboards form the largest percentage of refuse (i.e. 76.7%.).

The moisture content of domestic refuse varies from 40–60% depending on the prevailing climatic conditions but could rise to 80% during the wet season.

Refuse Generation in Metropolitan Lagos Area

The volume of domestic and commercial refuse generated in Metropolitan Lagos has been estimated (Lagos State Refuse Disposal Board, 1978) at 2,000 metric tonnes per day made up as follows:-

Region 1	—	1,000	tonnes per day
Region 2	—	400	tonnes per day
Region 3	—	600	tonnes per day
TOTAL	—	2,000	tonnes per day

At the time of writing, the Refuse Disposal Board had been operating in Region 1 for almost one calender year and experience gained from that operation had indicated that the percentage of the actual refuse arisings to the estimated was about 75%. Table 3 shows a comparison of the actual and estimated refuse arisings in Region 1 for the month of April 1979. It should be noted that the tonnage of refuse collected and disposed of will fluctuate depending on the weather and vehicle availability on any day. However, the figures for the month of April 1979 may be considered to be fairly representative of the current situation. These figures show that there were still parts of the Metropolis where refuse was not being collected and these locations had been identified e.g., solid wastes from Industrial establishments require to be collected and many drains were still filled with refuse which were not being cleared. Normal schemes to give effect to this had been introduced by the Board.

Refuse Disposal

There are different methods by which refuse may be collected and disposed of. The commonest methods used nowadays are the following:-

(*a*) Sanitary Landfill
(*b*) Incineration
(*c*) Composting.

It is not the intention of the author to discuss in this paper the relative merits and demerits of each of the methods listed above as this has been done by Ojikutu (1979).

Sanitary Landfill—As at present the system of refuse disposal is confined to sanitary landfill. There are two tips now in use i.e., Isolo and Anthony Village both in Region 2. Two other tips viz—Adeniji Adele Road and Makoko had recently been closed, covered with sand and prepared in readiness for handover to the appropriate Local Government for use as recreational grounds. With the two operational landfill sites in Region 2, considerable time is lost by the vehicles from Region 1 travelling to and from the tip sites thereby reducing the efficiency of the operations.

TABLE 3

ARISINGS OF DOMESTIC AND COMMERCIAL WASTE REGION—I APRIL '79

Area	Districts	Estimated Tonnage Tonnes per day	Actual Tonnes per day	(Actual) / (Estimated) %
Zone 1	Victoria Island, Ikoyi and Lagos	270	324	120·0
Zone 2	Surulere	280	144	51.4
Zone 3	Apapa	180	90	50.0
Zone 4	Ebute-Metta and Yaba	270	176	65.2
TOTAL		1000	734	73.4

In its bid to carry out the tipping operations in controlled and hygienic manner the Board had acquired a number of plant e.g., D.T. Caterpillars, D85A Kamatzu and John Deere bull-dozers, and excavator crawlers.

Incinerators—With the rapid rate of urbanization and development in Metropolitan Lagos the scarcity of suitable dumping sites within reasonable distance in the State is becoming more and more intractable. As a mark of the State Military Administration's determination to find a lasting solution to the problem of refuse disposal contracts for the installation of two straight incineration and one combined incineration/composting plant had been awarded. The incinerators (at Simpson Street, Lagos and Odaliki Street, Ebute Metta) and the composting incinerating plant at Oshodi would be capable of disposing 600,000 tonnes of refuse annually. This will not only provide three disposal stations but would also enhance the reclamation of marshy land through the use of the residue from the incinerators. It was hoped that a market for the compost would be found thus assisting the State's Agricultural programmes. The location of the incinerators and composting plant are shown in Figure 4.

Long-Term Master Plan for Refuse Disposal

The Master plan for waste disposal is centred on the already established plan for the division of the Lagos Metropolitan area into three Regions, each of which was subdivided into a number of zones. Each zone, based on a logical analysis of the area, acts as a catchment for waste as well as the base of operations of the refuse collection fleet and the other services of the Board. Three of the zones contain the incinerators and the composting plant, and would have transfer stations designed to permit the economic bulk haulage of refuse to the composting plant or the incinerators most convenient to them or permit the diversion of refuse to reserve landfill sites in circumstances when the new plants were out of action because of maintenance, or the correction of faults. An integral part of the use of the incinerators and the composting plant was the simultaneous development of a system to remove the ash residues from the Lagos Island and Ebute-Metta plant and likewise the removal of the compost and ash from the Oshodi plant. Acting with this was the development of emergency bypass transfer stations at the incinerators and composting plant to allow the continuity of the disposal service in the event of serious trouble at the plants. The disposal picture being completed by the development of one or two long term landfill sites outside the urban area and designed to receive the residues from the new plants, and untreated refuse, surplus to their capacity at times when the plants were on a reduced throughput of waste.

Maintenance Workshop

With a vehicle and equipment population of about 1,000 units, it became imperative for the Refuse Disposal Board to have and operate maintenance workshops.

The principal maintenance Workshop was situated in the Administrative headquarters of the Board at Iddo. The workshop provided an internal vehicle and plant repair and lubricating services. Since the take-over of the workshop from the Lagos Island/Lagos Mainland Local Governments in 1977, the workshop had not changed structurally but the unsightly scraps, junks and derelict vehicles which had littered the whole area in the preceding years had given way to a clean and tidy environment. It is pertinent to mention however that although the design, construction and equipping of the new structures to provide a standard and modern workshop were still in the pipe line, yet the workshop still provided satisfactory services.

For effective and efficient routine servicing and repairs the Maintenance Division admits of the following sections:

(*a*) Service Bay
(*b*) Heavy Vehicle Unit,
(*c*) Auto-electrical section
(*d*) Tyre section,
(*e*) Blacksmiths and Welders section,
(*f*) Carpenters
(*g*) Hydraulic and Panel beater,
(*h*) Painting and sign writing
(*i*) Light vehicle and plant sections.

Two other Workshops of similar structure were planned for Ikeja and Badagry Local Government areas in Region 3.

Training Programmes

The key to a successful system for solid waste Management and one which will continue to run smoothly when the expatriate managers return home is to have a properly designed and adequate training programme for the Nigerian Management staff and engineers, and to have well-equipped and back-up workshops for vehicles and plant.

Under the agreement signed with the expatriate

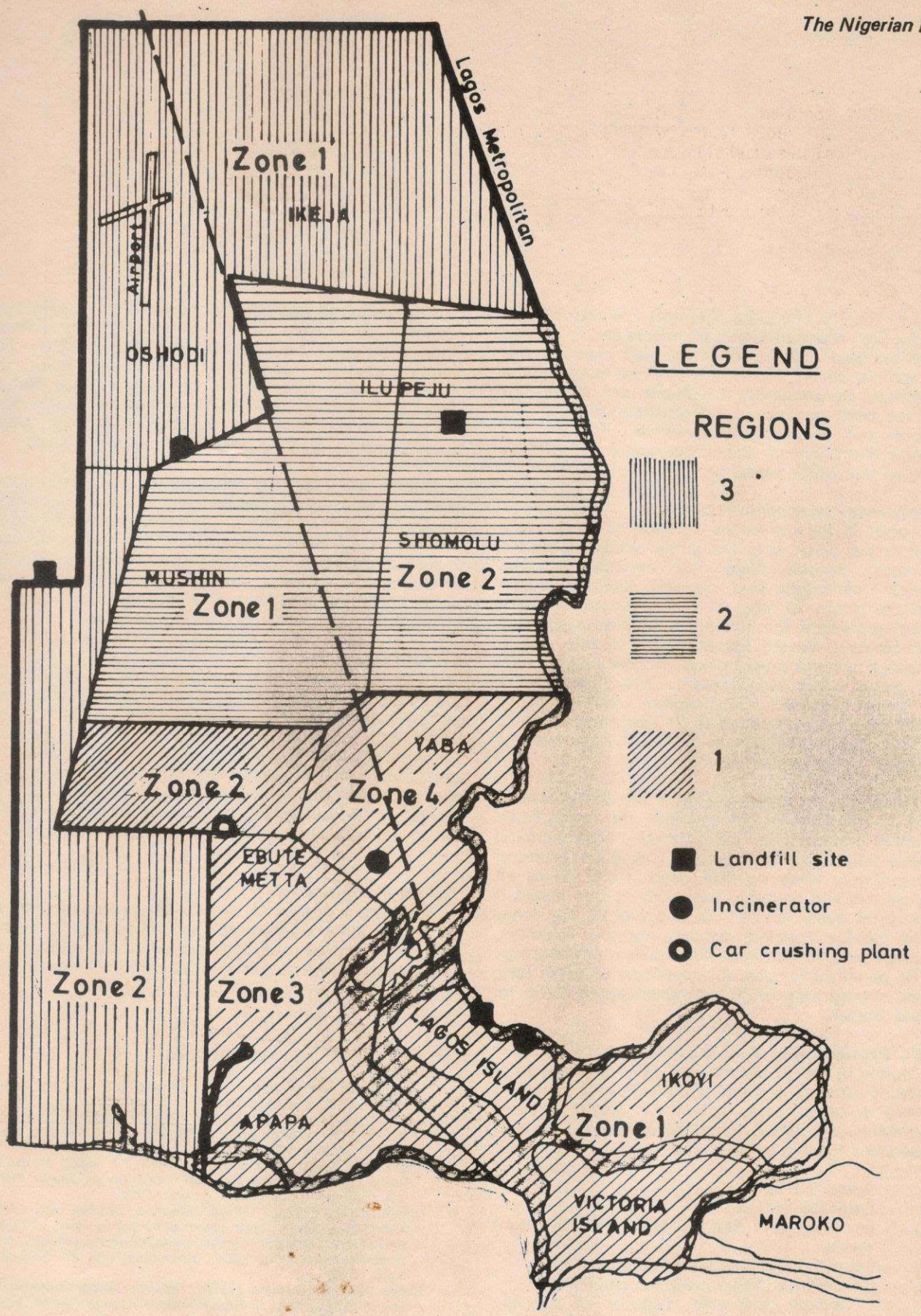


FIG. 4 LAGOS METROPOLITAN, REGIONAL AND ZONAL BOUNDARIES

consultants the PD (Pollution Control) Ltd was to train twenty six (26) Nigerian Senior Managers and Engineers and one hundred (100) supervisory staff including hydraulic vehicle drivers and refuse workers both locally and overseas. Consequently the Board runs a Training School for both junior and intermediate staff in the Operations and Maintenance Divisions. The training programme had provided added incentive to all workers particularly the junior workers.

Environmental Sanitation Education

The public is the key to the solution of solid waste problem in our cities. It is the public who creates the solid waste, discards them then expects effective, economical collection and disposal services. Unfortunately the public in most of our communities today does not appreciate the difficult problems associated with urban solid Waste Management. In this regard, public enlightenment programmes become an essential part of Solid Waste Management. The Lagos State Refuse Disposal Board, had therefore mounted series of public campaign programmes to educate the public of the metropolitan Lagos on the need for a way of achieving a clean environment.

To strengthen the determination of the State Government to rid the State of dirt and filth, the Lagos State Government enacted an edict titled "Environmental Sanitation Edict No. 19 (1978)". This Edict prohibits any person from throwing filth, rubbish and refuse on streets, gutters and drains in the State. It also makes it mandatory on every landlord or occupier of any tenement to provide covered dustbins for his tenement, which shall be used for depositing refuse of any description. The penalties for any contravention of these laws are fines ranging from ₦100 for individuals to ₦250 for corporate bodies.

Board's Problem and Aspirations

The duties of the Board did not cover all aspects of municipal cleansing services. The scope of municipal authorities in other parts of the world include the following in addition to refuse collection and disposal services for domestic waste:-

(*i*) Street Sweeping
(*ii*) Litter Prevention
(*iii*) Emptying and safe disposal of septic tank waste
(*iv*) Emptying and disposal of gully waste
(*v*) Collection and disposal of industrial waste
(*vi*) Collection and safe disposal of special (toxic) waste.

However, there had been a depression in the Nigerian economy and Lagos State Government had suffered along with other Governments of the Federation. The resulting economic constraints had slowed down the programme and progress of the Lagos State Refuse Disposal Board. Scarcity of personnel had aggrevated this problem and the Board had embarked on an extensive training programme both at home and abroad.

Despite the fact that there had been a remarkable improvement in the collection and disposal services in the State, there was still a number of problems to be solved and the Refuse Disposal Board was determined to find solutions by generating its own income with the introduction of the trade and industrial Waste Collection Service and the sale of scrap metal so as to become self financing and thus independent.

Conclusion

The author hopes that this paper had not only given the reader an exposition of Solid Waste Management in Lagos State, but had acquainted him with the operational and engineering activities of the Lagos State Refuse Disposal Board with a view to providing an opportunity for the assessment of its achievements and the appreciation of the problems encountered by the Board in the performance of its statutory functions of refuse collection. and disposal in Lagos Metropolis.

Acknowledgement

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